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Indian Standard

ROAD VEHICLES — BRAKE LININGS — SHEAR TEST PROCEDURE FOR DISC BRAKE PAD AND DRUM BRAKE SHOE ASSEMBLIES

ICS 43.040.40

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2006

Price Group 4

Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee, TED 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

This standard is based on ISO 6312 : 2001 'Road vehicles — Brake linings — Shear test procedure for disc brake pad and drum brake shoe assemblies' issued by the International Organization for Standardization (ISO). This standard is basically adoption of ISO 6312. Keeping in view the practical difficulties in testing the sample within 30 s after removal from the heating unit as specified in clause **7 (b)** of ISO 6312, the Committee responsible for the formulation of this standard has decided to adopt this ISO Standard with minor deviation as below:

> In clause **7 (b)** Substitute '60 s' for '30 s'.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

In reporting the results of a test or analysis made in accordance with this standard is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

ROAD VEHICLES — BRAKE LININGS — SHEAR TEST PROCEDURE FOR DISC BRAKE PAD AND DRUM BRAKE SHOE ASSEMBLIES

1 SCOPE

This standard specifies a method for measuring the strength of the bond connection between the lining material and the carrier in disc brake pad and drum shoe assemblies (shear strength). This standard is applicable to integrally moulded, riveted and bonded assemblies of both types of brake on road vehicles.

2 REFERENCE

The following standard contains provision, which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	*Title*
11852 (Part 1) : 2001	Automotive vehicles — Brakes and braking systems: Part 1 Terminology

3 TERMS AND DEFINITIONS

For the purpose of this standard, the terms and definitions given in IS 11852 (Part 1) and the following shall apply.

3.1 Lining — Friction material component of a brake lining assembly.

3.2 Carrier — Component of a brake lining assembly to which the friction pad is attached.

3.3 Bond Area — Contact area between lining and carrier.

3.4 Shear Strength — Ratio of the load at failure divided by the bond area.

4 SYMBOLS AND UNITS

The symbols and preferred units used in this standard are given in Table 1.

Table 1 Symbols and Units

Sl No. (1)	Quantity (2)	Symbol (3)	Unit (4)
i)	Shear force at failure	F	N
ii)	Area of bond	A	mm^2
iii)	Shear strength at failure	τ	MPa

5 SAMPLING AND CONDITIONING

This procedure may be used on samples during product development, on finished products, or after special treatment or usage.

Testing may be performed on a complete assembly or section of an assembly.

Sample edges my be prepared to ensure good contact with the loading and fixed tools. Shims should be removed.

When testing a lined shoe, the test area may cover the full assembly or segments of an assembly confined by saw cutting down to the carrier (*see* Fig. 1).

Five samples should be used.

NOTE — The test procedure applies a load in a direction which might not be in accordance with the loading direction of the product in service. The shear behaviour could be influenced by high aspect ratio, chamfered or slotted pads.

6 TEST RIG AND FIXTURES

6.1 Test Rig

The test rig shall be a compression or tensile testing machine or similar (shear testing) machine of sufficient capacity to apply the shearing load by activating a ram.

The test rig shall be provided with equipment to register the exact load applied at the instant of shear failure.

The load application rate shall be controlled in such a way that the load increases at an average rate of 4 500 ± 1 000 N/s (as determined from typical vehicle-based evaluation). If a constant crosshead speed machine is being used the load rate shall be set to 10 ± 1 mm/min. This shall be indicated in the results, which, it shall be noted, cannot be compared to tests conducted on machines of the constant load type. Shock loading shall be avoided.

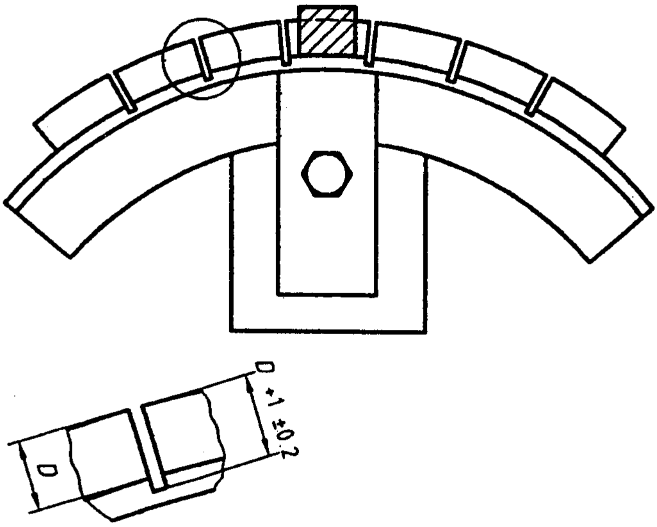
6.2 Fixture

6.2.1 *General*

The shearing test fixture shall have the means to hold a test sample such that it is parallel to the loading tool. This tool shall have a radius of 1.5 mm at the part in contact with the test sample.

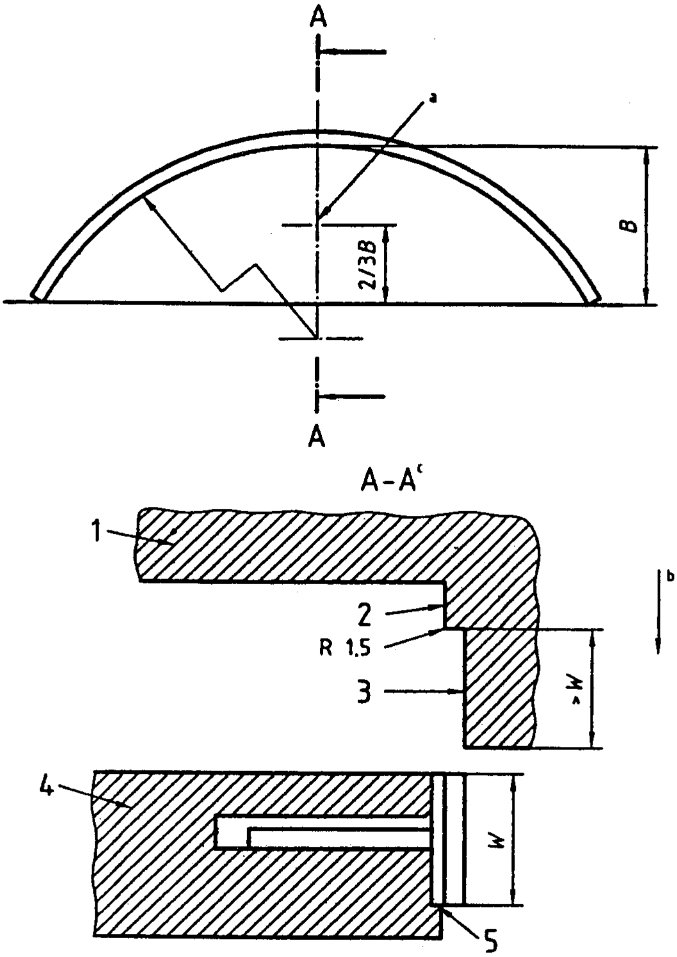
6.2.2 *Drum Brake Shoe Assembly*

The fixture (*see* Fig. 2) shall be designed so that the



All dimensions in millimetres.

Fig. 1 Lined Shoe in Segmental Test Condition



Key

1 = loading tool
2 = loading punch profile, 1 ± 0.2 mm clear of shoe platform
3 = lining face support
4 = fixed bottom tool
5 = shoe platform supported by tool (support ≤ platform thickness)
a = centre of thrust of top ram to be positioned thus
b = loading direction, parallel to shoe platform
c = through test tool

All dimensions in millimetres.

Fig. 2 Drum Brake Shoe Test Fixture

loading tool is in contact with the edge of the lining for the full sample length and thickness within 1 ± 0.2 mm of the shoe platform.

Load application on the loading tool shall be in a direction parallel to the plane of the shoe platform. The shoe shall be supported to maintain uniform loading along the length of the lining sample.

The width of the loading tool shall be greater than the width, *W*, of the lining.

6.2.3 *Disc Brake Pad*

The fixture (*see* Fig. 3) shall be designed such that:

a) Location of the plane of the backplate is parallel to the plane of the loading tool;

b) Loading tool is in contact with the edge of the lining within 1 ± 0.2 mm of the backing plate (carrier) and conforms to the sample lining profile including taper angles;

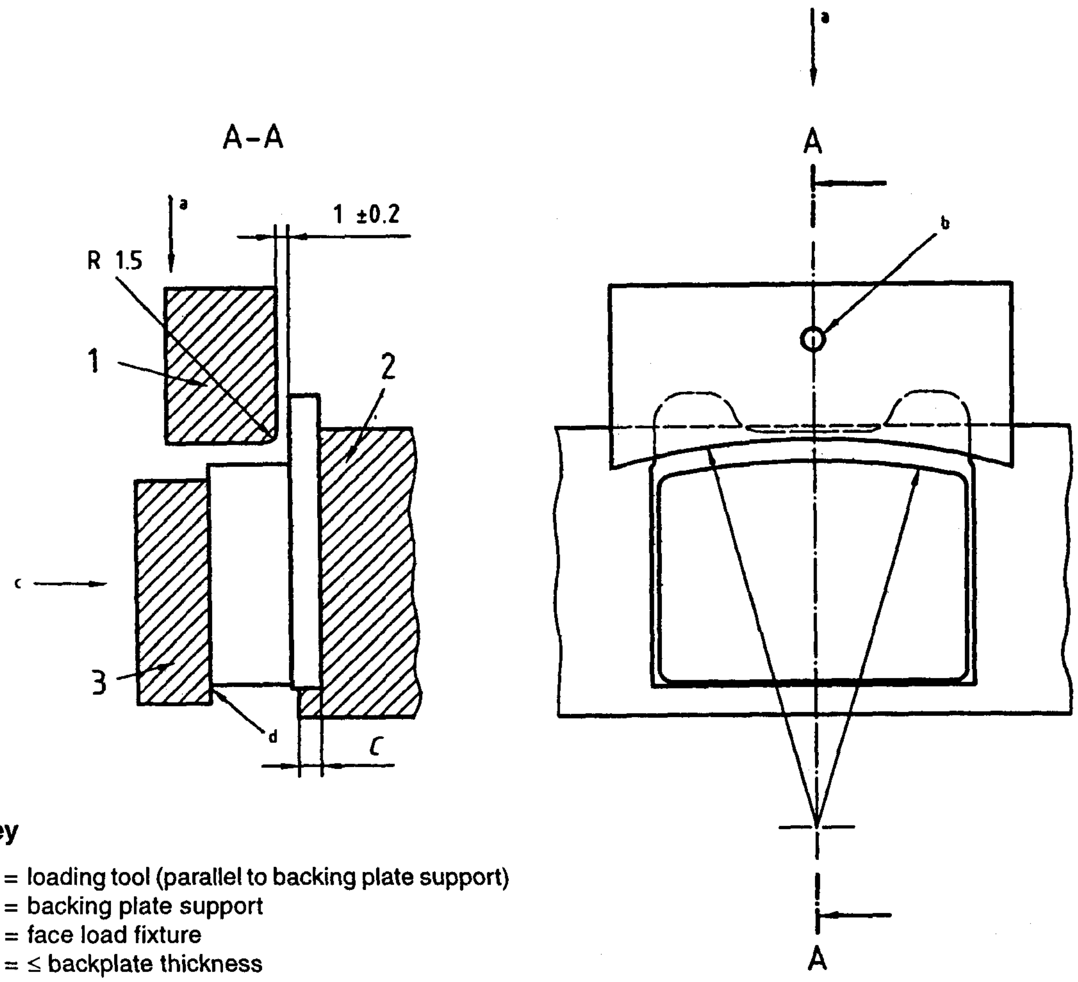
c) Loading tool is self-aligning;

d) Loading tool is in contact with the full sample length of the lining edge parallel to the backplate support;

e) Load bearing edge of the backing plate rests against a rigid support with a thickness no greater than that of the backing plate;

f) In order to prevent assembly movement under testing, a pressure fixture applies a face load of 0.5 ± 0.15 N/mm² of the lining area at a right angle to the shear load; and

g) Face load is applied in such a way that friction force is minimized and does not significantly influence the shear load measurement.



Key

1 = loading tool (parallel to backing plate support)
2 = backing plate support
3 = face load fixture
C = ≤ backplate thickness
a = direction of shear force
b = pivot
c = face load
d = minimized friction at interface

All dimensions in millimetres.

FIG. 3 DISC BRAKE PAD TEST FIXTURE

7 TEST PROCEDURE

The test procedure shall be carried out in accordance with the following (*see* Fig. 4 for a procedural flow diagram):

a) Conduct the test at ambient temperature 23 ± 5°C.

b) When shear tests at elevated temperatures are specified, heat the sample uniformly to a stabilized temperature within 30 min and test within 60 s after removal from the heating unit. Recommended temperatures are 200 ± 10°C for drum brake linings and 300 ± 10°C for disc pads.

c) Place the brake shoe or disc brake pad in the appropriate shear-test fixture.

d) Apply the load at the rate specified in **6.1**, continuing until complete failure occurs.

e) Record the failure load together with the shear pattern expressed as a percentage as specified in **9**.

8 CALCULATION OF SHEAR STRENGTH

Calculate the shear strength using the formula:

$$\tau = \frac{F}{A}$$

where

τ = shear strength, expressed, in megapascal (MPa);

F = shear force at failure, expressed, in newton (N); and

A = sample area, expressed, in mm^2.

Calculate A from the friction material profile at the bond line and not at the pad face, as chamfers or slots are pad surface effects.

The shear strength is expressed as the minimum and the average of the results of the number of samples tested.

9 PRESENTATION OF RESULTS

The test report (*see* Annex A) shall include the following information:

a) Type and supplier of the brake shoe assembly or disc brake pad friction material, and batch identification.

b) Number of samples tested (five recommended).

c) Minimum and average shear-force, or minimum and average shear-strength, values, or both.

d) A description of the shear pattern, based on:

    1) Percentage failure:

        i) of clean carrier,

        ii) of adhesive, and

        iii) in the lining.

    2) Location of any clean carrier areas.

e) Comments (including mention of samples used as specified in **5**) on deviations from normal test conditions such as special test temperature.

Test Procedure Flow Diagram

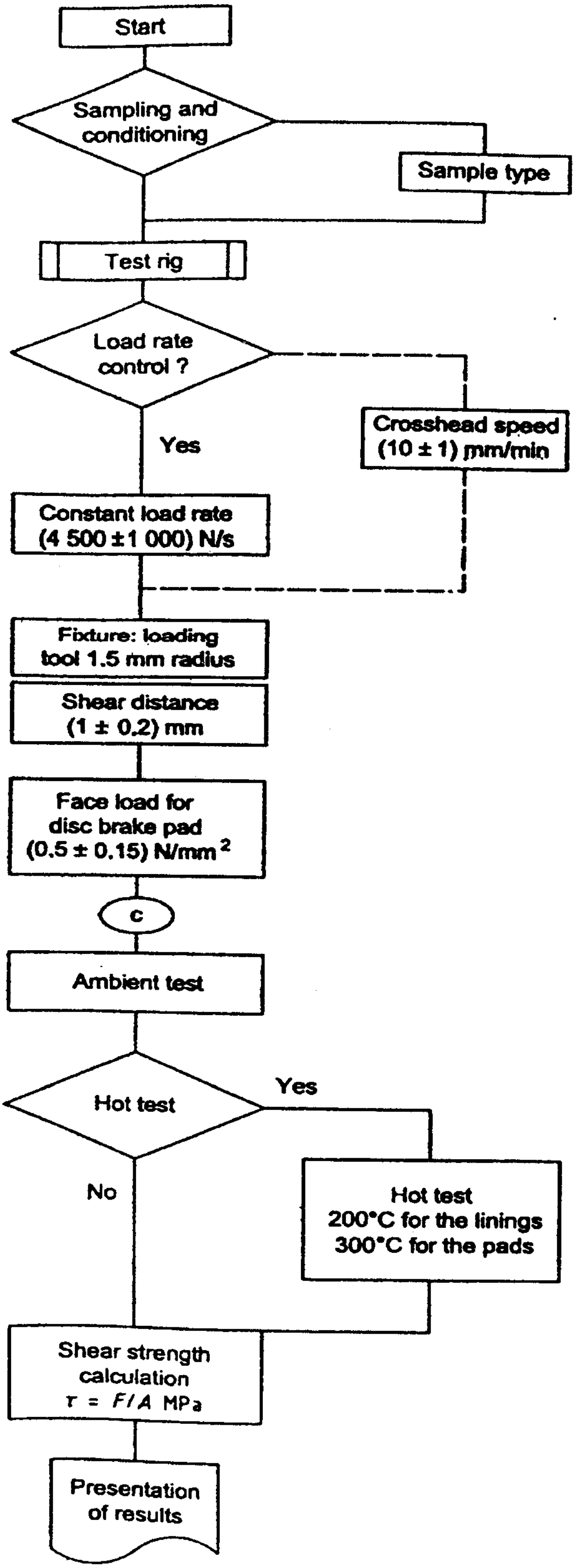

Start
Sampling and conditioning
Sample type
Test rig
Load rate control ?
Crosshead speed (10 ± 1) mm/min
Yes
Constant load rate (4 500 ± 1 000) N/s
Fixture: loading tool 1.5 mm radius
Shear distance (1 ± 0.2) mm
Face load for disc brake pad (0.5 ± 0.15) N/mm²
c
Ambient test
Hot test
Yes
No
Hot test 200°C for the linings 300°C for the pads
Shear strength calculation τ = F/A MPa
Presentation of results

FIG. 4 TEST PROCEDURE

ANNEX A

(*Clause* 9)

TEST REPORT

A-1 The presentation of the test parameters and report of results is as given in Table 2.

Table 2 Test Parameters and Report of Results

Parameter	**Constant Load**	**Speed Transverse Load**
Load rate	4 500 ± 1 000 N/s	10 ± 1 mm/min
Distance from carrier to loading tool	1 ± 0.2 mm	1 ± 0.2 mm
Loading tool radius	1.5 ± 0.5 mm	1.5 ± 0.5 mm
Face load	0.5 ± 0.15 N/mm^2	0.5 ± 0.15 N/mm^2
Heating test		
Heating duration	30 min	30 min
Test dwell time after heating	30 s	30 s
Test temperature for drum brake lining	200°C ± 10°C	200°C ± 10°C
Test temperature for disc brake pads	300°C ± 10°C	300°C ± 10°C
Manufacturer of lining		
Lining reference		
Batch identification		
Sample type	Full pad/pad section/full lined shoe/segment of lined shoe/other	
Sample size		
Sample area at point of shear	mm^2	
Special coatings		

Ambient Test			**Hot Test**		
Number of samples test (five recommended):			Number of samples tested (five recommended)		
Minimum shear strength	:	MPa	Minimum shear strength	:	MPa
Mean shear strength	:	MPa	Mean shear strength	:	MPa
Failure mode					
Clean carrier	:	percent	Clean carrier	:	percent
Adhesive	:	percent	Adhesive	:	percent
Failure in lining	:	percent	Failure in lining	:	percent
Location of clean areas	:		Location of clean areas	:	
Deviation from test procedure	:				
Test date	:				
Name of tester	:				
Reference No.	:				

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee, TED 4

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This Indian Standard has been developed from Doc: No. TED 4 (538).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at Simco Printing Press, Delhi